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Feasibility analysis and development of on-road charging solutions for future electric vehicles

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Analysis of AIMD-based DSM for EV wireless charging on the move

***Theodoros V. Theodoropoulos, Ioannis G. Damousis, Evangelia Portouli, Angelos J. Amditis**, Institute of Communication & Computer Systems, Greece*
***Nadim El Sayed**, DAI-Labor, CC NEMO, Germany*
***Stephane Laporte**, Institute VEDECOM, France*

Additive Increase Multiplicative Decrease methodology for Demand Side Management in dynamic EV charging: ICT and results of microscopic mobility simulations for representative traffic patterns

Necessity
- Grid operators avoid overloads on cables and transformers
- The owners of local renewable use the locally produced energy to charge EVs

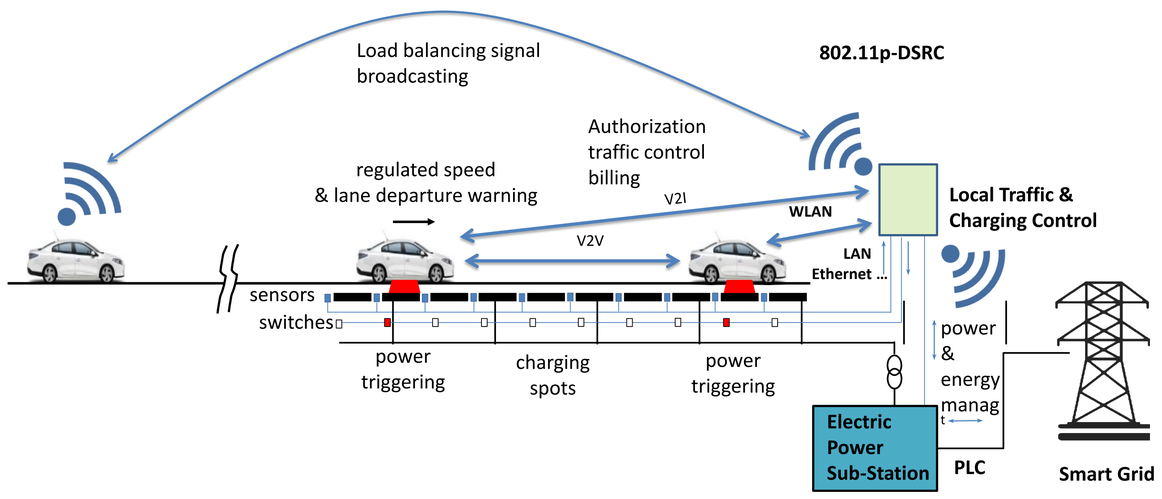
Approach
- Distributed, agent based load balancing
- Minimal communication and processing latencies
- Approach in line with the 802.11p DSRC standard.

Outcome
- Fair charging among all EVs.
- Demand-supply balance in RES, microgrid environments.

Objectives

- ✓ Scalable architecture for massive dynamic charging rollout
- ✓ ICT infrastructure for highly responsive adaptation to DSM events
- ✓ Assessment of the load balancing approach under demanding traffic conditions

Architecture



Technical Approach

The algorithm is based on a simple concept; EV charging power is increased additively when no power constraints occur at the infrastructure side. On the occurrence of a power constraint, Evs multiplicatively decrease, their charging power.

A scenario that shows the responsiveness of the system in case of a low speed, high traffic scenario where vehicles move at 10km/h over a 1km long charging lane is presented. A drop in supply from 2000kW to 500kW is simulated at t=400s and the system adapts the demand accordingly. The system restores the balance in 600ms approximately.

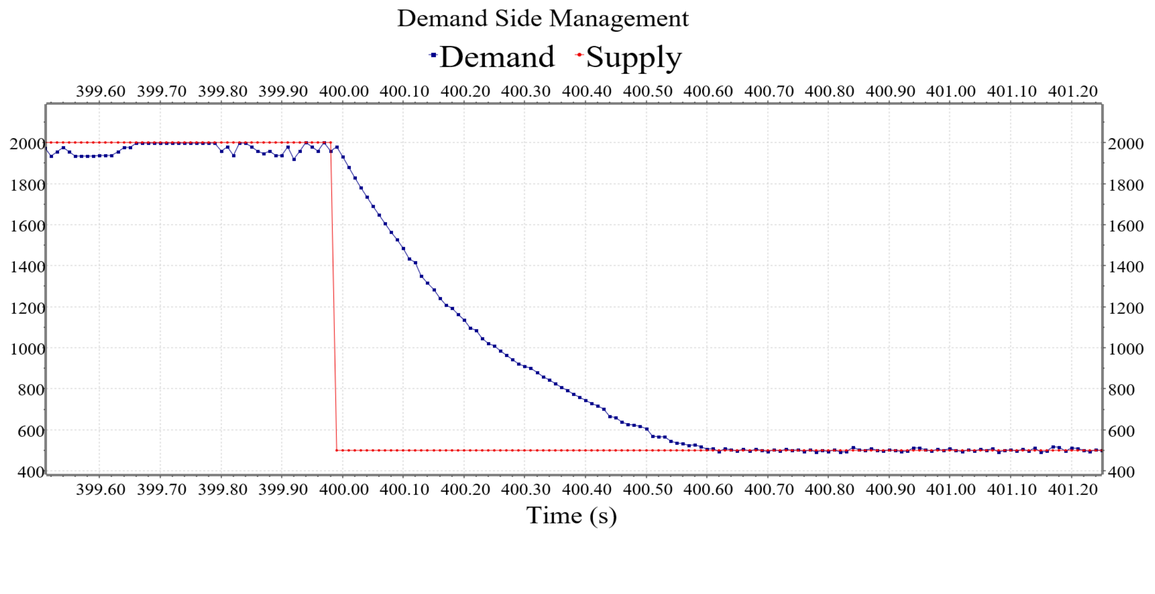
$$p(t+1)=p(t)+a \qquad (1)$$

$$p(t+1)=\beta p(t) \quad \beta<1 \qquad (2)$$

Results

Simulations over various traffic patterns over a 1km charging lane have revealed:

- ✓ Sub second balancing given DSRC V2I communications and a 10ms demand measurement period
- ✓ High frequency demand metering further enhances event responsiveness.
- ✓ Fair shares for charging across all EVS
- ✓ Demand-Supply mismatch can be further minimized by super-capacitors installed at the primary side of the charging lane



Project Facts

Budget	9 M€	**Funding**	6.5 M€
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Coordinator	Angelos Amditis, ICCS	**Contact**	a.amditis@iccs.gr

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